

Blast Effects Analysis with the CartaBlanca Computer Code

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CartaBlanca [1] employs modern discretization schemes and solution methods for nonlinear physics problems on unstructured grids in 1D, 2D, and 3D. CartaBlanca has been used to simulate multiphase flows, fluid-structure interactions, heat transfer and solidification, and free-surface flows. The Arbitrary Lagrangian-Eulerian (ALE) method is used to provide flexibility with regard to physical models, and the Material Point Method (MPM) is used to effectively trace large deformations of materials with mechanical strength. In MPM, state information such as density and stress of the material is carried by discrete computational particles that are free to move within the problem domain. The basic equations solved in CartaBlanca are based on multiphase flow theory. Each phase is allowed to have its own stress (or pressure) field evolving according to its constitutive relation (or equation of state). Heat, mass, and momentum transfer can be calculated. One of CartaBlanca's greatest strengths is in the tight coupling between fluids represented by ALE meshes and solid structures represented by MPM particles.

Shown here are results from a CartaBlanca simulation of an explosion in a parking garage, at 55 ms and 146 ms after the explosion of a truck bomb. The calculation used MPM to represent the garage structure (light gray particles) and an underlying substrate (dark gray particles). The response of the ambient air is calculated with the ALE method. An

isosurface of air pressure at 5 bars is shown with the solid (red) surface. In these figures the front of the garage is removed to allow a clear view of the interior of the explosion and the garage response.

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[1] <http://www.lanl.gov/projects/CartaBlanca/>

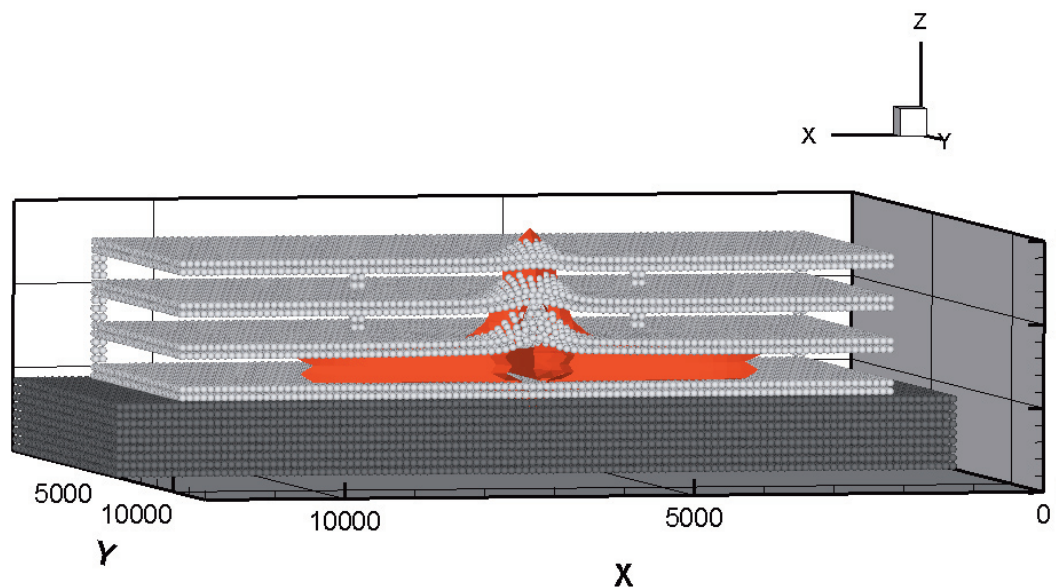


Fig. 1. Simulation of an explosion in a parking garage 55 ms after the explosion of a truck bomb.

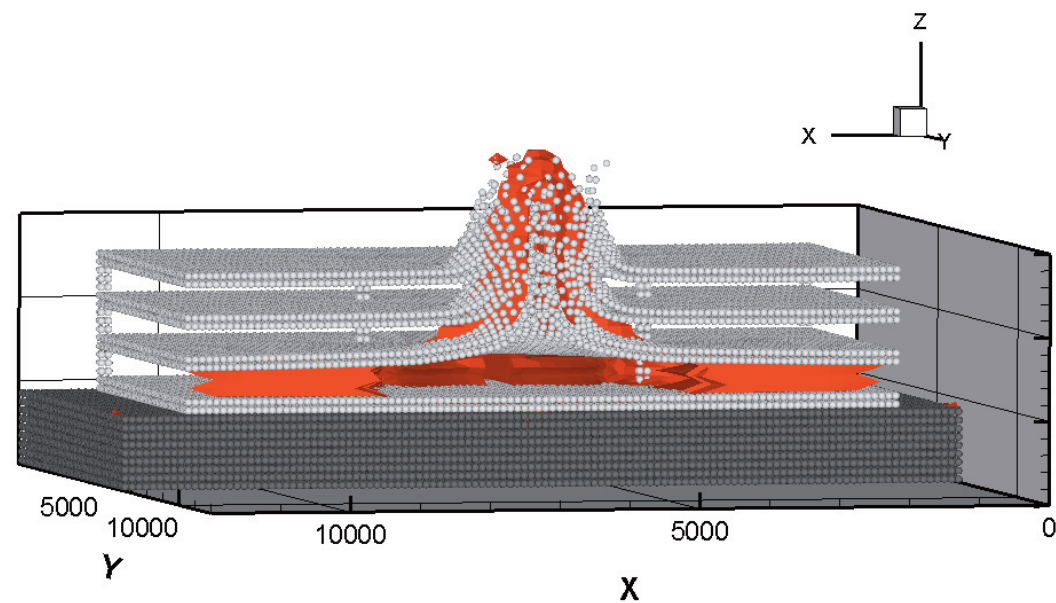


Fig. 2. Simulation of an explosion in a parking garage 146 ms after the explosion of a truck bomb.

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